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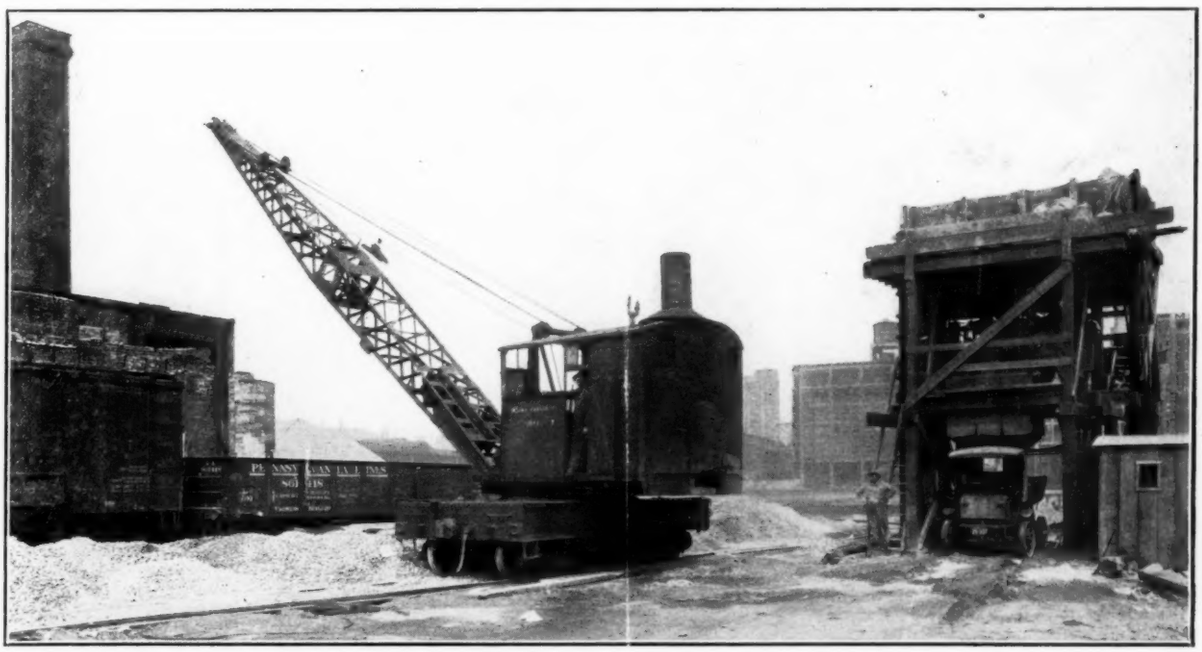

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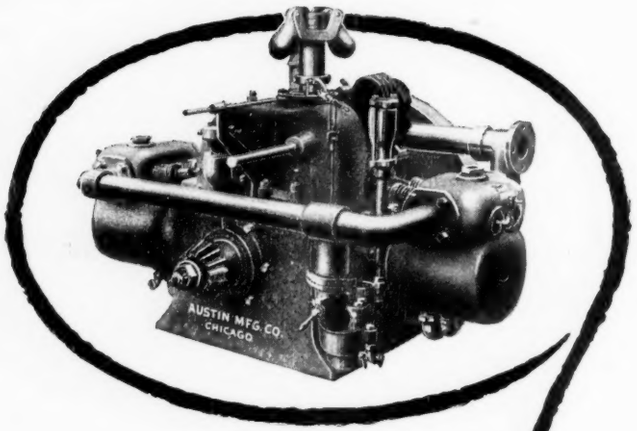
IN THIS ISSUE

Lining Rock Tunnels in New York
Relation of Water Resources to Forestry
Building San Pablo Filters
Sewage Treatment at English Aerodromes
Highway Construction in Illinois
Denver's Municipal Asphalt Plant

AUGUST 28, 1920

THE AUSTIN-WESTERN ROAD MACHINERY CO.



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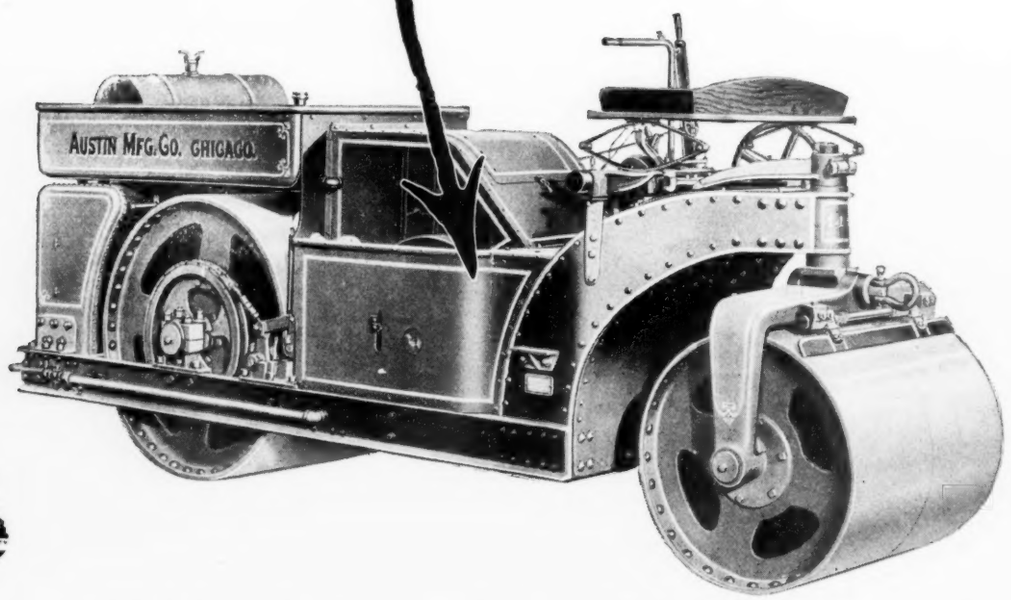

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A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 49 FLORAL PARK, AUGUST 28, 1920 No. 9

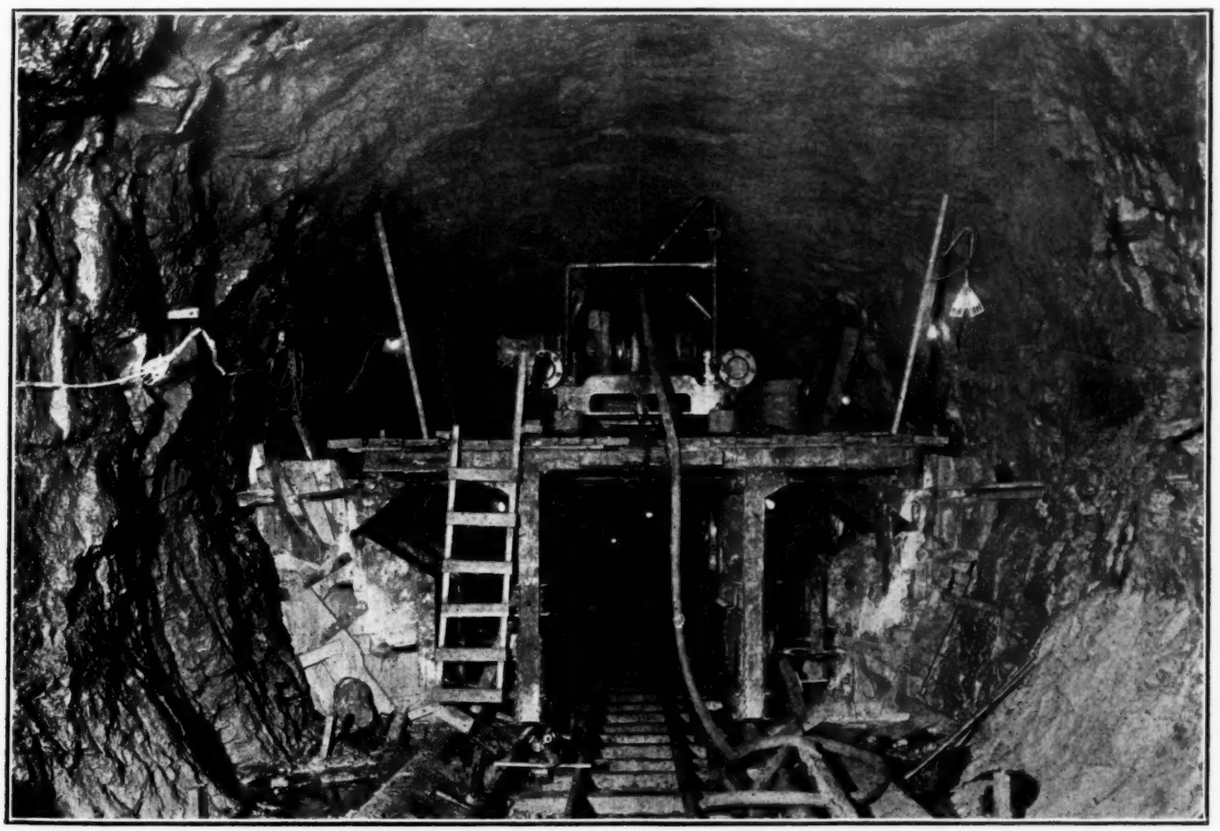
Lining Rock Tunnels in New York

Steel forms for roof arch and side walls. Concrete hauled in dump cars and pulled up inclined plane to platform at skewback level.

Several thousand feet of the land approaches to the three twin-tube tunnels under the East river that have recently been built for the New York Rapid Transit subway, were driven under atmospheric pressure through rock by the full width top heading and bench method, making an excavation about 18 feet square. This excavation was lined with concrete, having a finished interior radius of about 15 feet 6 inches for the arch, a flat invert, and offset sidewalls containing the duct banks, the same as the lining for the cast iron tubes.

CONCRETING INVERT AND SIDE WALLS

All of the concrete used for the lining was mixed in plants installed in the bottoms of the shafts as was the case for the cast iron tubes, and most of it was delivered to the forms in steel side-dump cars hauled by electric locomotives on narrow-gage tracks laid on the finished invert.



STEEL TRAVELER SUPPORTING SIDE WALL FORMS IN APPROACH TO SUBAQUEOUS SECTION OF TUNNEL. HOISTING ENGINE INSTALLED TO OPERATE INCLINED TRACK FOR CONCRETE CARS

The invert concrete was dumped from the cars directly to the bottom of the excavation, where it was placed without the use of forms, being dressed to the required surface by screed and straight edge.

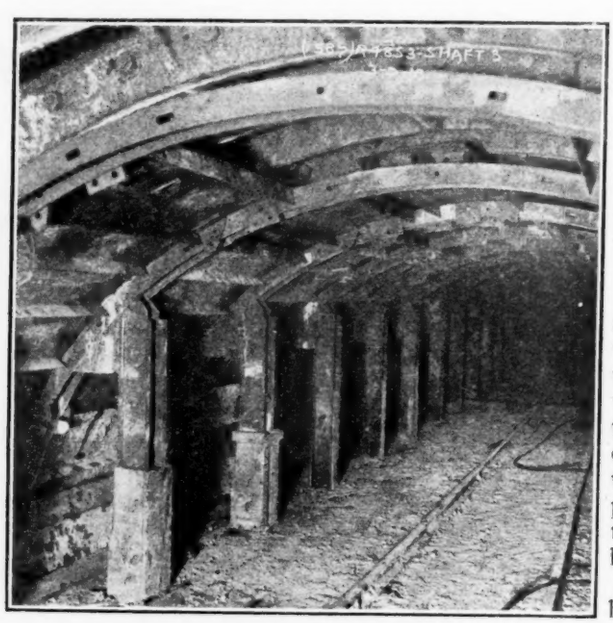
After the completion of the invert, a wide-gage track was laid on it concentric with the service track, and on this was installed a steel traveler with steel transverse bents placed 5 feet on centers and each consisting of a pair of vertical posts supporting a horizontal cap. The vertical posts were connected by longitudinal members at the top, bottom and center, and the caps were covered with planking forming a platform just above the axis of the tunnel and providing below it a clearance for the service track and for the transportation of plant and materials without interrupting concreting operations.

The traveler bents were assembled in sections long enough to make up about 100 feet and supported, from the overhanging end of the caps, steel ribs covered with wooden lagging which constituted the forms for the inner surfaces of the sidewalls, suitable to receive the duct banks which were subsequently built on them.

These forms were connected top and bottom to the traveler posts by turnbuckle struts that enabled them to be moved in or out horizontally, while the bolted connections to the end of the cantilever cross beams above could be removed, permitting the forms to be raised or lowered when stripping and transferring them. Wooden bulkheads, carefully scribed and set to fit the irregularities of the rock excavation, were bolted with steel scabs to the forms at the end of each section to retain the concrete in a vertical plane at the construction joint.

STANDARD ARCH FORMS

The arch concrete was placed by the means of standard all-steel forms identical with those used for the arch lining in the cast-iron tubes. The semi-circular form ribs were made with 6-inch channels, the webs horizontal and the flanges slotted to receive connection bolts through surface plates riveted to the steel lagging plates from about 15 to 48 inches long and 5 feet wide which were supported on the ribs.



STEEL ARCH FORM IN OLD SLIP—CLARK STREET TUNNEL

Each rib was made in three sections with bolted joints at the haunches, where gusset plates were provided and two vertical steel columns by which the forms were supported. Frequently the columns were enclosed with plank boxes to protect them from concrete and from impact and injury. The ribs were assembled 5 feet apart longitudinally to make sections about 100 feet long which were concreted in a single operation. The lagging plates were assembled successively from the skewbacks up as the concrete was placed in position, leaving an open space at the crown for placing the concrete. Some of these plates were provided with holes closed by tap bolts to allow for the subsequent grouting. The slotted holes in the ribs allowed for some adjustment to the irregularities of the work and facilitated making connections. The arches were struck by the operation of wedges under the supporting columns.

The accompanying view of the arch centers is from a photograph taken of their use in the cast-iron tubes, and the floor shown in that view is the concrete platform on top of the traveler cap just above the axis of the tunnel.

CONCRETING ARCH LINE

In the cast iron tubes and in most of the rock tunnel, after the sidewalls had been completed nearly up to the springing line, there was cast on them a skewback section reaching up a little above the axis of the tunnel to receive the arch concrete.

The concrete for the sidewalls and for the arch lining, excepting a small portion that was delivered by the pneumatic process near the bottoms of the shafts, was hauled up an inclined plane attached to the forward end of the form traveler, using a steel cable operated by a compressed air hoisting engine installed on top of the traveler, as shown in the accompanying picture. The concrete was then dumped on the platform and shoveled by hand into the wall forms and arch forms.

UNDERPINNING THE ARCH LINING

For a length of about 250 feet in both the north and the south tunnels of the 60th Street line in the approach under the Queensboro bridge, it was desirable to preserve the greatest possible width in the lower part of the rock tunnel so as to have clearance adjacent to the bulkhead at the end of the air pressure section. For this reason, the invert, sidewalls and duct banks were temporarily omitted in the early part of the operations, and were not built until after the arch lining had been completed.

After the excavation had been completed, the bottom was trimmed approximately level in the center, a service track was installed on it and vertical piers like pilasters were built against the

face of the rock wall on each side and capped at the springing line by longitudinal concrete sections forming skewbacks for the arch. Subsequently the arch centers were set up between the pilasters, the lagging adjusted to bear against the skewback concrete and the concrete placed between the form and the top of the rock excavation, completing the arch, which was thus permanently supported on the pilasters while the full horizontal clearance of 15½ feet was left in the bottom of the tunnel for construction operations. The forms and travelers were removed and, when other portions of the work had been completed, the invert was made and the sidewalls were built permanently inclosing the pilasters and completing the tunnel lining.

This work was executed by T. McGovern & Company, as contractor. Some of the other rock tunnel work was done by Booth & Flynn, contractor. All of the steel forms and travelers were supplied by the Blaw-Knox Company. The work was designed and built under the direction of the Public Service Commission, D. L. Turner, chief engineer, and C. M. Holland and C. G. Drew successively engineers of tunnel construction.

Improving a Soft Trench Foundation

Portions of the Winnipeg reinforced concrete aqueduct of 100,000,000 gallons per day capacity were built in shallow open trench excavated in clay soil which would crack on top and, admitting water would swell up, enclose the water and allow it to permeate and saturate the sub-soil, making it semi-fluid and destroying to a great extent its bearing capacity.

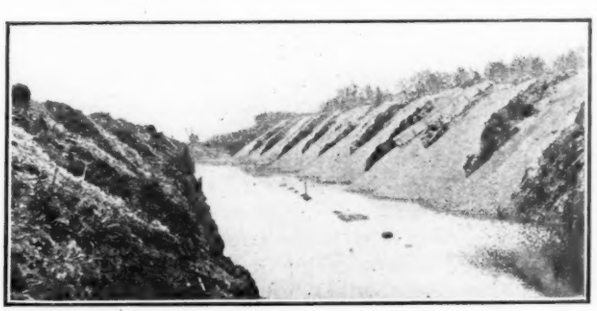
Sometimes when the soil was first exposed in excavation it appeared solid and capable of carrying heavy loads; but it was liable to great change and deterioration, which sometimes occurred before the structure could be built or was liable to follow after the aqueduct had been concreted and backfilled.

In order to avoid the expense of excavating to a great depth through this material, it was in some cases covered and protected by a thick layer of sand and gravel dumped on the soft, wet bottom of the trench that before would scarcely support the weight of a man.

Sumps were sunk through the gravel at frequent intervals and the water pumped out of them, thus drawing it from the bottom of the stratum rather than from the surface and automatically producing a very effective tamping of the gravel and solidification of the soft clay.

This was very successful, the sand and gravel becoming so dense that it required a pick-axe to remove it, and a splendid footing was secured on which to concrete the invert of the aqueduct.

The operation was much quicker and cheaper than digging through the soft material and provided a satisfactory foundation which did not settle under the load of the finished aqueduct and its contents. The work was designed and executed under the direction of James H. Fuertes, consulting engineer, New York.



TRENCH WITH VERY SOFT BOTTOM COVERED WITH WATER-TAMPED SAND AND GRAVEL

Deepening Hell Gate

About forty years ago one of the most difficult blasting operations that had been conducted up to that time was successfully completed for removing "Flood Rock" in Hell Gate, located between New York harbor and Long Island sound. Until the removal of this rock it had been practically impossible for any but the smallest craft to pass by water between the harbor and Long Island sound. Since then smaller ocean-going coastwise craft had been able to pass through Hell Gate, but it is proposed ultimately to secure a passage for large ocean going steamers through this stretch of the East River.

At present, contractors are removing Frying Pan reef, which is 480 feet by 360 feet. The dredging company expects this work to extend over eight or ten months because of the short period of time each day when certain of the necessary operations can be performed. A drill boat is warped across the reef in paralell lines about 30 feet apart, drilling holes in each line. From 100 to 150 lbs. of dynamite is placed in each hole and, after they have been exploded, a dipper dredge loads the broken rock into scows. Except at slack water, the current at this point is so swift that it is only between tides that drilling points can be located, charges planted and fired, or the position of the plant changed, and such slack water generally lasts not more than 20 to a maximum of 23 minutes. Divers employed on this work are generally unable to spend more than 15 minutes under water at each slack-water period, or a total of 30 minutes a day. When this reef has been removed, Pot Rock and other less dangerous reefs will be attacked. It is expected that the completion of the channel will require 15 or 20 years and an expenditure of $55,000,000 to $75,000,000.

New York Permits Lime in Concrete

Use of hydrated lime in concrete has been permitted under certain restrictions for use on construction work in Greater New York, under a decision recently made by the Board of Standards and Appeals of that city. The matter came before this board on an appeal from a ruling on the use of hydrated lime in concrete work in the construction of a large building. After securing

testimony from all available sources, the board reached the following decision:

"The use of hydrated lime in all classes of concrete construction shall not be prohibited when used in accordance with the conditions hereinafter set forth.

"The hydrated lime shall conform with the Standard Specifications of the American Society for Testing Materials.

"The maximum amount of hydrated lime which may be used shall conform with the following:

1-1½-3 mix; 4 lbs. of hydrated lime per 95 lb. bag of portland cement.
1-2-4 mix; 5 lbs. of hydrated lime per 95 lb. bag of portland cement.
1-2½-5 mix; 6 lbs. of hydrated lime per 95 lb. bag of portland cement.

"For hand-mixed concrete, the hydrated lime and portland cement shall be well mixed while dry.

"Hydrated lime shall not be used in concrete which is to be deposited under water."

Relation of Water Resources to Forestry*

By THORNDIKE SAVILLE †

The author sums up in this paper the accepted facts relative to flood control, erosion, evaporation, drainage of swamps, protection of water supplies and other branches of the subject, and explains the principal features of the recently enacted Waterpower Bill.

The relation of water resources to forestry is complex. The subject may be considered from three standpoints: first, the effect of forests upon the occurrence and distribution of water, or the hydrological relation; second, the effect of forests upon public health and scenery from their presence on municipal watersheds and reclaimed swamps, or the public welfare relation; and third, the effect of forests upon waterpower, navigation, agriculture, etc., or the economic relation. These three relations may be analyzed in accordance with the following outline:

I. *Hydrological*:
  (*a*) Flood control.
  (b) Regulation of run-off and its relation to evaporation and seepage.
  (c) Erosion and silting.
II. *Public Welfare*:
  (*a*) Protection of public water supplies.
  (*b*) Drainage of swamps and conversion to productive woodlands.
  (*c*) Provision for parks and recreation areas.
III. *Economic*:
  (*a*) Conservation of water and forest resources.
  (*b*) Erosion and silting; effect on nagivation and agriculture.
  (*c*) Employment of construction labor during winter months.
  (*d*) National forests and water resources.
  (*e*) State and municipal forests and water resources.

I. HYDROLOGICAL

(*a*) *Flood Control.* A considerable literature has grown up in the past ten years relating to the effect of forests upon the magnitude and frequency of floods. Eminent scientists and engineers have violently espoused each side of the controversy. Proponents of forestry measures have made startling claims for the favorable influence of forests in mitigating the evil effects of floods. Some engineers have made equally inclusive statements as to the entire absence of any beneficial effects of forests upon flood control. As a result, due to the emotional appeal of the forestry advocates, the general public has an exaggerated idea of the benefits of forests upon flood mitigation, and scientists are bewildered by the conflicting statistics of engineers.

Out of all of this mass of contradictory evidence a few general principles may be regarded as well established. In mountainous districts, where the streams are bordered by steeply sloping hills the forest cover serves to reduce both the frequency and magnitude of the average flood, and consequently is highly beneficial. After protracted rainfall, when the cover has become saturated, this effect is absent. Therefore, the maximum floods, even in mountainous regions, are little affected by the presence of forests. The relative beneficial effect of forest cover decreases with increase in size of the mountain stream. On very large rivers, or on rivers draining a rolling or flat country the presence of forests does not seem to affect the magnitude or frequency of floods.

(*b*) *Regulation of Run-off.* Like the preceding, this has long been a moot question, and, as above, the beneficial effect of a forest cover is most evident upon the run-off of streams draining a mountainous territory. The forest roots and humus undoubtedly retain much water from rain storms, and deliver some part of it later to the streams, thus conserving what might otherwise go to waste on flood flows. Moreover, the shading effected by trees serves to retard the melting of snow, and the evaporation from the land surface. On the other hand the

*Address before North Carolina Forestry Association, Asheville, N. C., June 10, 1920.

†Associate Professor of Hydraulic and Sanitary Engineering, University of North Carolina.

evaporation from rain and snow on the leaves is great. The consumption of water plant growth is, however, less for trees than for any other kind of vegetation. Conifers are the best trees from nearly all stand-points of water conservation. As before, these conditions are most favorable for regulating stream flow in regions of steep gradient where the water from average rains seeps rapidly into and through the humus and is fairly quickly delivered to the stream. The discharge is thereby rendered more constant. In regions of flat gradient the presence of forest cover may be disadvantageous in that seepage is less rapidly removed, increasing the amount of water evaporated by vegetation or used in plant growth, and reducing the discharge of the streams.

(*c*) *Erosion and Silting.* Removal of forests inevitably causes extensive gullying of the slopes, with consequent transportation of the eroded material to the streams. The result, from a hydrological standpoint, is two-fold. First, the regimen of the streams is distrubed. They must carry a load of detritus beyond the capacity attendant upon their normal gradient. This means deposition, building up of the stream bed, alteration of the course of the stream, and transportation of debris to points below, where navigation and flow in a larger stream may be adversely affected. Second, the detritus washed from the deforested land is transported by the streams and deposited in any reservoirs created for water supply, water-power, or irrigation purposes. Forestry enthusiasts have stressed the importance of forests in the regulation of flood flows and run-off. The effect of deforestation in causing erosion and silting is probably more important and of more far-reaching consequence. The beneficial effects of forests upon these is very considerable.

II. PUBLIC WELFARE

(*a*) *Protection of Public Water Supplies.* The protection of impounded public water supplies from all possible sources of pollution demands ordinarily a minimum use of the watershed for domestic or agricultural purposes. The best kind of watershed, from a hygienic standpoint, is one thickly wooded. Cities are rapidly coming to pursue a definite policy of forestation upon their watersheds used for domestic water supply. This policy is carried out from the double relation of health and economy. The economy aspects of the question are discussed later. Closely related to the forestation of watersheds is the protection of reservoirs from dust, and the effect of decreased evaporation due to adjoining woods.

(*b*) *Drainage of Swamps.* Within recent years the drainage of swamps as an anti-malaria measure has been carried out on a constantly increasing scale. The results may be three-fold: first, the elimination of malaria; second, the reclamation of valuable agricultural or building land; and third, the conversion of vast tracts of useless land into ground suitable for forestation.

(*c*) *Provisions for Parks and Recreation Areas.* The creation of parks and open spaces where people living in congested districts may get good fresh air and a chance for out-of-door recreation has become a well-established adjunct of any municipal or state public welfare program. There has been a pronounced tendency of late years on the part of cities to make beauty spots of their water supply areas. The reservoirs near the city are equipped with attractive buildings, and shade trees to serve as open spaces and recreational centers. The larger areas on the water-shed are laid out with walks and drives, experts in landscape architecture and forestry are retained to formulate a policy, and the district is made attractive to automobilists and excursionists from the city. The thoughtful planning of the environs of municipal watersheds was begun by the Metropolitan Water Board in Boston under the direction of the late Frederick P. Stearns. Here miles upon miles of beautiful drives lead the automobilist about the secluded reservoirs and lakes; while the tramper, picknicker, or boy scout, finds countless paths leading through the wilder portions of the reservation. The whole project is under the guidance of an expert forester and landscape architect. This plan so successfully pursued in Boston has been followed by Hartford, Conn., New York, Asheville, N. C., and other cities, in the prosecution of extensive additions to their water supply areas. The drives and forests about the watersheds are annually attracting thousands of visitors.

III. ECONOMIC

(*a*) *Conservation of Water and Forest Resources.* The conservation of water resources is affected by the greatest economic use, and is two-fold. The waters not utilized, and which would otherwise be wasted, are set to productive use; and thereby (in the case of water-power) a corresponding saving is effected in nonrenewable energy sources such as coal or oil. With increased cost of fuel, and difficulty in transporting it to inland points, the development of water-power projects has been tremendously stimulated during the past few years.

At present the demand for electric power is far beyond the supply in many parts of the country. Public utility corporations have hesitated to enlarge their plants for two reasons: first, the difficulty in obtaining labor and materials and the high prices for these, and second, the reluctance of public service commissions to allow increase in rates to cover increased cost of new development. This attitude has made it difficult for corporations to obtain money for new improvements. Where water-power sites existed upon navigable streams the policy of the national government has not been such as to make private power developments practicable. This is now remedied by the recent enactment of the Water-power Bill, which will tremendously stimulate developments in some parts of the country, and the effects of which are discussed separately hereafter.

In some of the eastern states the larger water-powers have nearly all been developed. There still remains a vast amount of power in the smaller falls and streams, which individually may not be economically developed. It is now possible, through the utilization of the induction generator, to develop a number of such streams, interconnect them, and tie them into a larger controlling system. They will then feed into the system a variable amount of power, depending upon the season. The develop-

ment of district water-power schemes of this sort, which in part at least may be automationcally controlled, is one of the most hopeful means of increasing electric power output in manufacturing regions. Several installations are already in operation. Newer developments will probably follow some such scheme as is outlined in the Super-power project for a great trunk line system from Boston to Washington, an investigation for which is provided in the last Sundry Civil Appropriation Bill.

Like water-power, the conservation of forest resources is affected by maximum judicious use. The principles of selective cutting and reforestation are too well known to need discussion here. Just as water-power has become finally recognized as a national asset needing Federal control, so should general regulations of state and nation control the promiscuous destruction of our forests.

A double conservation is possible here also, through electrification of the steam railways. Thousands of acres of valuable forest land are annually destroyed through fire caused by sparks from locomotives. The electrification of the railways in forest regions thus not only effects economy in fuel conservation and operating expenses, but also in preventing the waste incident to forest fires.

(*b*) *Erosion and Silting.* The hydrological effect of erosion and silting caused by deforestation has already been discussed. Next to the destruction of the timber itself probably the gravest economic loss arising from removal of the forests is in the silting of navigable streams and the destruction of valuable bottom lands. Instances are not uncommon where navigable streams which a score of years ago required little maintenance of channel, now need constant dredging to remove the deposits brought by floods from the denuded mountain sides. This effect is felt far distant from the source of the trouble, and the material eroded from mountains by torrential streams may eventually cause deposits on a large navigable stream hundreds of miles away. Once the damage is done, reforestation and flood control works are the only palliatives of the cause. Both have beeen extensively practiced by the French in the Alps, at great expense. A sound forest policy will eliminate the necessity for such regulatory works.

Some of the most valuable and productive land in upland regions lies in the valleys of the streams. As deforestation proceeds, with consequent erosion, the stream sides are aggraded by the transported detritus. In consequence, at times of flood the water overflows the banks, causing washouts, gullying and destroying the fertile valley bottoms. The remedies and preventives are the same as those described in the preceding paragraph.

(*c*) *Employment of Construction Labor in Winter.* The beneficial effects of forests upon watersheds used for domestic water supply has been mentioned previously. An important corrollary of this is the opportunity which municipal or state forests give for the employment of construction labor during the winter months. The present scarcity of skilled labor makes it imperative that laborers experienced in water works, sewer or road construction be retained throughout the year. If they can be utilized in forestry work on the watersheds during the winter months, they will not be a dead load on the pay roll. The cities of Hartford and New Haven, Connecticut; Boston, Massachusetts; and Nashua, N. H., have practiced this combination of forestry and labor conservation with great success. Even if value of the wood cut will not show a profit, a careful policy will make expenses meet, and serve to hold skilled labor. After a decade or more of such procedure, there may be some actual profit from the forestry operations, as the labor becomes more skilled in lumbering and the value of the timber available for cutting increases.

(*d*) *National Forests and Water Resources.* Since 1901 the Secretary of Agriculture has been empowered to issue permits for "the occupancy and use of National Forest lands for the construction, maintenance and operation therein of project works for the development, transmission and use of power." The policy of the Department has always been to encourage the development of water-power projects on national forests, but in spite of the fact that many excellent sites exist, relatively few projects have been undertaken. This has been due largely to the provisions of the act which allows the Secretary to revoke a contract at will; to impose new rental rates after a lapse of ten years; to treat appreciation of land as income for rate making; and to other broad powers of the Federal government. Such regulations have made investments by private capital unattractive.

The Water-power Bill (H. R. 3184) which has just become law makes definite provision for the development of sites on the national forests, and eliminates many of the disadvantages enumerated above. A Federal Power Commission, consisting of the Secretaries of War, Interior and Agriculture is appointed, which has very broad powers regarding all use of the waters subject to regulation by the United States. Licenses will be issued for a period of fifty years, and are revocable only after civil procedure in the federal courts. The passage of this bill will undoubtedly stimulate greatly the development of water-power projects on the public domain.

(*e*) *State and Municipal Forestry and Water Resources.* Where power shortage exists, and power companies are unwilling or unable to extend their plants, the question of municipal and state enterprises become important. Adequate power is so essential to the development of any territory that a municipality or state can afford to expend large sums in water-power developments with a much less return on the investment than a private company, since the difference is the intangible return from the possession of power which attracts industry to the city or state. The development having been made, the operation of it to supply power is most economically made by long term lease to a public utility company.

The enactment of the National Water-power Bill is of vital concern to all states, since the powers of the national government under the terms of this bill are so sweeping as to seriously affect state control of its water-power resources unless certain provisions are made. It especially behooves states or municipalities containing national forests or the headwaters of navigable streams within their

boundaries to act quickly to preserve to themselves the administration and control of water-powers situated therein. The Power Commission is authorized to issue licenses for and administer the operation of water-power developments on the "navigable waters of the United States, or upon any part of the public lands and reservations" (including national forests), and to direct the "construction, maintenance and operation of headwaters or other improvements of streams upon which the Commission is authorized to issue licenses." This means that a farmer desiring to erect a 150-horsepower mill on a small stream tributary to a navigable river must have a federal permit, or have his project modified and perhaps controlled by federal regulations.

The act further provides that applicants for federal licenses must have "complied with the requirements of the laws of the state or states within which the proposed project is to be located with respect to bed and banks and to the appropriation, diversion, and use of water for power purposes and with respect to the right to engage in the business of developing, transmitting and distributing power" . . . and that nothing within the act "shall be construed as affecting or intending to affect or in any way to interfere with the laws of the respective states relating to the control, appropriation, use, or distribution of water used in irrigation or for municipal or other uses, or any vested right contained therein." For states not provided with laws relating to water use or water-power the act provides "that in case of the development, transmission, or distribution, or use in public service of power by any licensee hereunder or by its customer engaged in public service within a state which has not authorized or empowered a commission or other agency or agencies within said state to regulate and control the services to be rendered by such licensee or by its customer engaged in public service, or the rates and charges of payment therefor . . . jurisdiction is hereby conferred upon the Commission. . . . to exercise such regulation and control until such time as the state shall have provided a commission or authority for such regulation and control." Moreover, the bill specifically provides especially favorable terms for state or municipal developments in the national forests.

Excellent as the provisions of the Act are in furthering water-power development in the United States, it is evident that such states as do not have conservation commissions, a geological survey, or other agency authorized to investigate and regulate the use of the water-power in that state are likely to be at great disadvantage. Certain states have near their boundaries great water resources. If these are developed by extra-state corporations and the power transmitted to the adjoining state for industrial use, the owner state loses the utilization of a valuable natural resource. If a city is situated near a national forest, a private manufacturer may use the water resources of the forest under Federal license, and the municipality, desiring to extend its power facilities or water supply may have to go a great distance and be at great expense to provide what it should have available near at hand. It is evident that the provisions of the Water-power Bill are eminently fair and favorable to states and municipalities, but they must be provided with the administrative machinery to preserve and utilize their water resources. Several states, not so provided with water use laws, or commissions for their enforcement, have recently been stimulated to provide them by the passage of the Water-power Act. Those states or municipalities having water resources of magnitude will do well to immediately investigate their potentialities, enact laws regarding their use, and provide a commission to investigate and regulate the development of power projects, whether or not these come under the provisions of the Water-power Bill.

Report on Milwaukee's Water Supply*

Rapid sand filters recommended, of 160 million gallons capacity and with special coagulant-mixing devices, and chlorine treatment, estimated to cost $4,580,000.

RECOMMENDATIONS

"As a result of the study of the detailed data set forth in this report, and from a knowledge of local conditions obtained from personal observation for a period of more than a year, certain conclusions have been reached which have been embodied in the following recommendations:

"1. That, in view of the present polluted condition of the city's water supply and the probable continuance of dangerous contamination, even if the best methods now known are used to dispose of the sewage of the city, there be constructed a filtration plant of the rapid sand type, and that the project be gotten under way immediately.

"2. That this filtration plant be located on the lake front near the shore shaft of the Linwood avenue intake tunnel.

"3. That on account of the increasing consumption of water by the rapid growth of the city, the filter plant be constructed to have a capacity of not less than 160 million gallons per day, based upon the usual rate of filtration for this type of plant, and that it be so designed that extensions of the plant may be made in the future.

"4. That in designing the filter plant, advantage be taken of certain information gained in the experimental work, namely, that adequate mixing of coagulating chemical solutions with the water may be obtained in comparatively simple devices of much less cost than those now commonly employed; that a period of sedimentation after coagulation be provided of not less than three nor more than four hours, based upon theoretical displacement; that a filter sand be used, having an effective size of not less than 0.35 m.m., nor more than 0.40 m.m.; and that conduits and pipe lines be provided of such size

*Continued from page 170

that rates of filtration from 15 to 20 per cent in excess of the nominal rate may be utilized.

"5. That disinfection of the water after being filtered be practiced as a second line of defense against contamination; that chlorine be used for this purpose, and that the amount applied be approximately one-half that which was used on an average in treating the raw water supply of the city during 1919.

"6. That no attempt be made at the present time to employ ozone as a disinfecting agent for either the raw or filtered water, since the experimental evidence obtained indicated the apparatus had not been developed sufficiently to produce ozone at low enough cost to enable it to compete with chlorine as a disinfecting agent; and that the first cost of installation and the subsequent cost of operation and maintenance would be too high for use in a large municipal plant of the size required by Milwaukee.

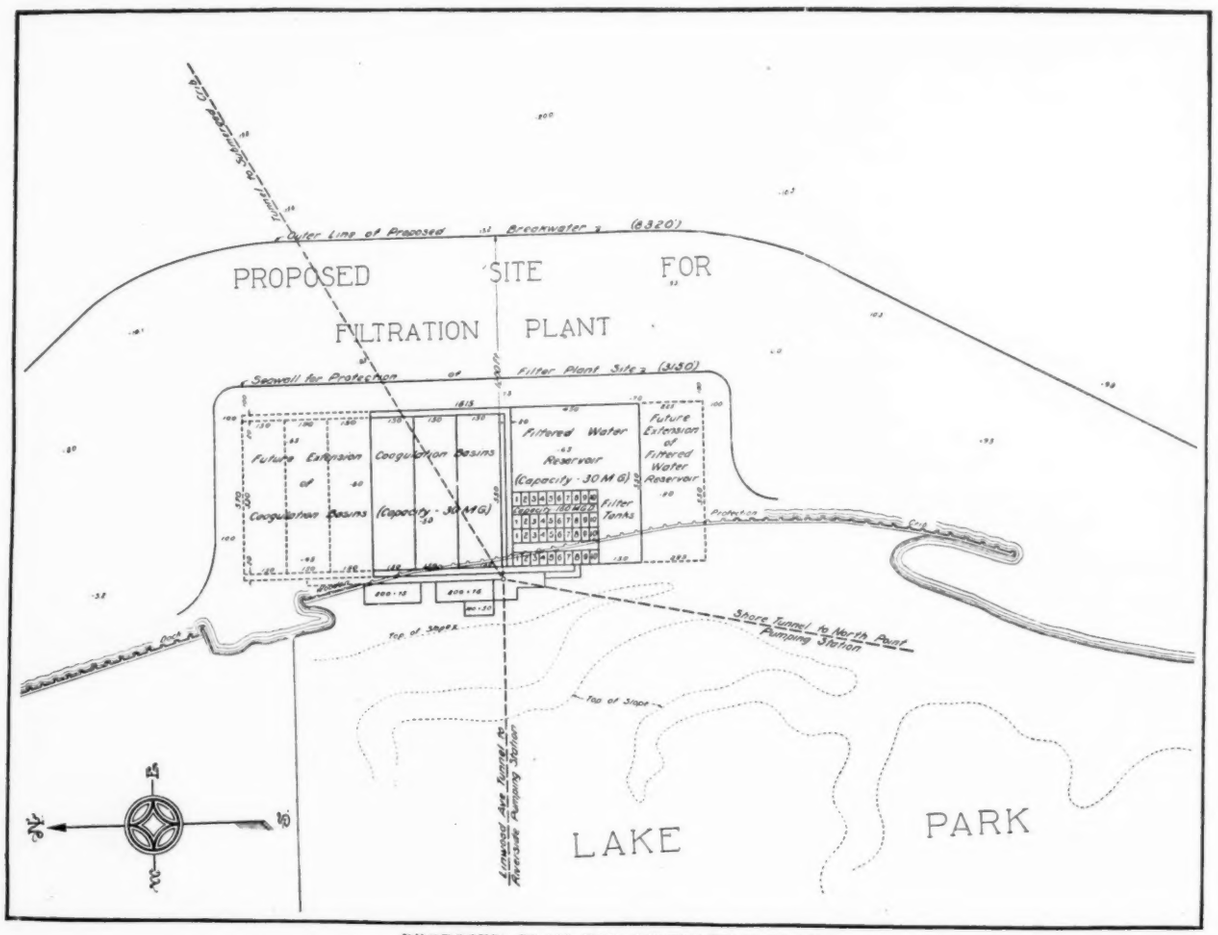
ESTIMATED COSTS

Owing to present conditions as to prices of materials and labor, it would not seem practicable to make any very reliable estimate as to the cost of a plant which, if begun at once, would not be completed for several years; and yet it was necessary to form some idea of what the cost would be. In making this estimate Mr. Ellms based his figures on plants of similar size to the proposed plant, and present prices.

The site which seemed most suitable of those available for the plant was on the lake front near the present intake tunnel, the shore tunnel which conveys water to the North Point pumping station, and a new tunnel now under construction. He selected the junction of the intake tunnel running west to the new pumping station. But there is little room on land for building a filter plant at this point and land will have to be made into the lake at an estimated cost, including protection wall, of $382,700. He believes, however, that a plant at this point would become an object of great interest to the public, and would add materially to the beauty of the contemplated improvements along the shore of the lake.

In addition to the cost of the protection wall and filling of the site, the estimated cost includes $867,440 for foundations, including excavation, coffer dam and piles; $782,000 for coagulation basins, mixing flume and discharge conduits; $1,500,000 for filter tanks, piping, valves, gates, filter equipment and filtered water reservoir; $448,000 for chemical house, wash-water tank, and low-service pumping station; to which is added 15 per cent, or $600,000, for contingencies and engineering, giving a total of $4,580,140.

The cost of operation includes that of lifting the water from the intake shaft to the mixing flume. From this point it will flow by gravity to the filtered water basin and thence through


Outer Line of Proposed Breakwater (6320)
PROPOSED SITE FOR FILTRATION PLANT
Seawall for Protection of Filter Plant Site (3150)
Future Extension of Coagulation Basins
Coagulation Basins (Capacity - 30 M G)
Filtered Water Reservoir (Capacity - 30 M G)
Filter Tanks
Future Extension of Filtered Water Reservoir
Shore Tunnel to North Point Pumping Station
Top of Slope
LAKE
PARK

PROPOSED PLAN FOR FILTRATION PLANT

tunnels to the pumping stations. The cost of this pumping should be included as part of the cost of purification. There would be a total lift of 35 feet, and the cost would be approximately $1.80 per million gallons if done with electric motors driving centrifugal pumps, or 70 cents per million gallons if the pumps are driven by steam turbines; these costs being based upon a combined efficiency of pumps and motor of 75 per cent of the water horse power, and electric current at $1.25 per k.w.h.; and steam at a cost of 35 cents per thousand pounds, with 13.6 pounds per horsepower-hour. These figures are for power only. Purification is estimated to cost about $4 per million gallons, of which the cost of the chemicals will be about 40 to 45 per cent, the balance being for labor and materials for operation and maintenance. Disinfection with chlorine is included in the chemicals but would cost only about 15 to 20 cents per million gallons. As for ozone disinfecting, it was estimated that, with electricity at 1 cent per k.w.h., the production of the ozone alone would cost over $4 a million gallons, while that of compressing and applying it would probably exceed this, and in addition there would be a loss of head by water in passing through the ozone towers. It appearing that the cost of disinfecting by ozone would be approximately 50 times as great as by chlorine, no attempt at accurate estimating was made.

Summing up, assuming a plant of 160,000,000 gallons daily capacity and a cost of $4,500,000, the operation and maintenance charges would be from $5 to $6 per million gallons, and the fixed charges about the same, or a total of $10 to $12 per million gallons. This would amount to only 1 to 1.2 cents per thousand gallons, which is certainly a small amount to pay for insurance against water borne diseases as well as for providing a clear and brilliant water of the most acceptable character.

Changes in Garbage Disposal Proposed at Portland

Municipal collection of garbage, or at least a complete change from the present method of garbage disposal in Portland, Oregon, seems inevitable. The city council on July 30 authorized a call for bids for the privilege of either collecting or disposing of Portland garbage. With such bids before the council by September 10, it is hoped that some proposal may be submitted to the voters at the November election.

City commissioner Bigelow has investigated various proposals made by reduction plants and garbage collection agencies and said he was satisfied that some plans suggested would be more satisfactory to the city, both from a financial and a health viewpoint, than the system now in operation.

It is the plan of commissioner Bigelow, approved by the council, to obtain bids from firms and individuals prepared to tackle the Portland garbage problem. Bids will be called for through advertisements intended to reach all persons interested in the subject.

Such bids must be submitted to the council by September 10, after which time the council will make a careful investigation of the various proposals and select the most suitable for submission to the voters.

The Los Angeles plan is looked upon with considerable favor.

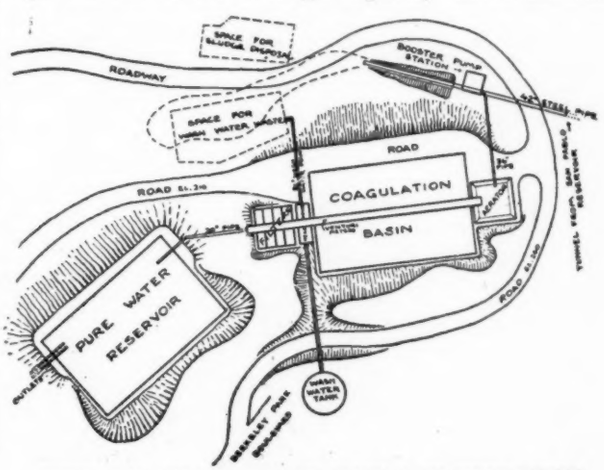
Under the present system of garbage collection in Portland it is estimated that not more than one-third of all the garbage is collected and destroyed at the incinerator. The collection is in the hands of private collectors who charge a monthly fee for their services. The charge results in many people in the city refusing to utilize the present system. Garbage disposal by individuals, in many cases, is said to be a menace to public health.

At least a dozen firms operating throughout the United States are expected to bid for the privilege of collecting garbage in Portland, or paying for the garbage the city will collect in the event the voters indorse the plan.

Building San Pablo Filters

Best equipped and most modern filter in California, built on steeply sloping land. Also the highest hydraulic-filled dam in the country.

The water supply for Alameda, Oakland, Berkeley and a number of smaller California municipalities on the east side of San Francisco Bay is provided by the East Bay Water Company, the total amount supplied being in the vicinity of 20 million gallons daily. This is nearly the maximum capacity of the water sheds and reservoirs controlled by the company, and about four years ago it began the construction of what is known as the San Pablo project, which will give it an added average capacity of 12 million



GENERAL PLAN OF SAN PABLO PURIFICATION PLANT

gallons a day, with a peak capacity 50 per cent greater. The cost is estimated to be about $3,500,000. The following description of the construction work on this project, and especially of the filter bed, is condensed from an article in The Excavating Engineer.

The project comprises a dam in the San Pablo canyon, a water shed lying east of the Berkeley hills, an outlet tunnel through these hills, and a filtration plant on the west slope of the hills.

The dam is of earth, hydraulic-filled, with a crest 1350 feet long and 55 feet wide. It has been carried 140 feet above the creek bed and forms a reservoir with a capacity of 7,250 million gallons. It is proposed ultimately to carry it 40 feet higher, when its capacity will be 14,000 million gallons and the water will be backed up the canyon for 5½ miles When completed, it will probably be the highest hydraulic-filled dam in the country, with a base from toe to toe of approximately 1400 feet, and contain 2,100,000 cubic yards of material. Work has been temporarily suspended on the dam at the height of 140 feet, but it is expected that it will be resumed in the fall.

The water from this reservoir is brought to the distribution system of the company by a tunnel 13,563 feet long through the Berkeley hills, passing 1,000 feet below their crest The tunnel is 5 feet 6 inches by 6 feet 6 inches, horse-shoe shaped, and lined with concrete with an everage thickness of 8 inches. It has a slope of 1 in 1,000. This tunnel passes under Wildcat Canyon and here a shaft 305 feet deep brings the water from the creek bed down to the tunnel beneath. The dam and tunnel are being built by Bates & Borland of Oakland as contractors.

FILTRATION PLANT

At the western end of this tunnel the water is discharged into a filtration plant which is said to be the best equipped and most modern of its kind in California. From the tunnel the water enters a 42-inch steel pipe line which discharges through a net work of pipes into an aerator basin 80 feet square. Adjacent to this basin is a double coagulation basin 300 feet long by 170 feet wide, divided into two basins by a middle partition wall. The water passes through a Venturi meter in going from the aerator to the coagulation basin.

After receiving the coagulant, the water passes through the headhouse to the filter beds, of which there are eight arranged in a double row of four each. The net area of each bed is 532 square feet. A wash-water tank is placed on the hill above the plant, giving pressure for washing the filters. Another small reservoir still further up the hill furnishes water at a higher constant pressure for operating the hydraulic valves and other auxiliaries. The plant is so laid out that space is left for eight more filter beds when these are needed.

From the filters the clear water pases to a pure-water reservoir having a capacity of 6 million gallons, from which reservoir it passes directly into the distribution system. The reservoir is 351 feet by 169 feet, with a concrete roof which will be covered with 3 feet of soil and sod.

All the water used in washing the filters will be carried to small basins, where the solid matter will be allowed to settle out and the water be pumped back to be filted again, no water, therefore, being wasted.

Excavating for the filtration plant was begun in July, 1919, and on January 7, 1920, excavation work was finished. The excavating was done by means of an 18B Bucyrus revolving shovel on caterpillars. The ground had a slope averaging 17 degrees and in some places reaching 45 degrees, and all of the basins were made in cut and fill, the excavated material being used for the embankments on the lower sides, the most impervious materials being placed so that they would come next to the concrete work. Fresno scrapers were used for levelling the embankment and also on side-hill work to form benches for the fills. The material excavated was about 30 per cent sandstone and the rest a conglomeration of disintegrated sandstone, shale, and igneous rock. Blasting was used for about 75 per cent of the material. The maximum depth of excavation was 51 feet. All of the excavation was done by the shovel named, except that for about three weeks a Thew ⅝-yard revolving shovel was used in addition.

The clear water basin required 43,000 cubic yards of excavation, the coagulation basin 24,000 yards, the filters 15,000 yards, the aerator 1,000 yards, and the wash water basin 1,500 yards; a total of 84,500 cubic yards. This material was hauled an average distance of about 400 feet by 2-yard Troy wagons.

From 8 to 13 wagons were used, the average being 11, and they were so well organized that the shovel never had to wait for a wagon but worked steadily, with practically no breaks in the schedule of making a complete cycle in 20 seconds. Three horses were used on most of the wagons, although an occasional snatch team was used for hauling and fuel.

All suitable material was used in making the embankments, and the successive layers were rolled by means of a 10-ton Austin steam macadam roller, the slopes of the embankments being finished by hand.

The steam shovel averaged about 500 yards a day of eight hours, the highest record being an average of 600 yards a day for a period of 23 days. All the work was carried on with one operator, one fireman and one general untility man.

The filtration plant will cost about $500,000 and was designed by Hazen, Whipple & Fuller of New York. The resident engineer in immediate charge of the work was George W. Hawley.

Highway Engineering Scholarship

J. G. Culbertson, manufacturer of automobile trucks, has established at the University of Texas, a scholarship with an annual income of $300, to be awarded every year to a student specializing in highway engineering.

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Soft Spots in Road Subgrades

A theory, or possibly it might better be called a suggestion, as to the cause of the formation of soft spots in subgrades under roads, especially in clayey soil, was given to the writer by James H. Sturdevant, division engineer of the New York State Highways, while discussing the breaks which occurred in the highways of his division this spring and which were described in our issue of August 14. It will be recalled that the numerous breaks in this instance were caused by a combination of an unusually long, wet spring accompanied by the travel over the road of a very great number of very heavy trucks.

It is Mr. Sturdevant's idea, as we understood it, that, had the number of trucks been very much less, perhaps only those which used the roads under previous conditions, even though the individual weights had been as heavy, these breaks would not have occurred. He cited as an illustration of his idea that, if wet clay be struck with a tamper or a hammer, moisture would appear at the surface but in a few seconds would be reabsorbed by the clay. If, however, continuous repeated blows be delivered at a single point, the moisture from considerable depth would be forced to the surface, and this would become more saturated and finally of jelly-like consistency. The same phenomenon might be considered as occurring in the clay beneath a pavement when this receives, from heavy truck wheels, repeated blows in more or less rapid succession, such blows being sufficiently heavy to be transmitted through the foundation to the clay beneath. The effect would be to bring moisture to the surface and, where the conditions were such as to concentrate at one point a sufficient amount of moisture, this would finally produce a clay so soft as to no longer have sufficient stability to support the load, even though distributed over considerable area by a macadam base 15 inches thick, or by a concrete base 6 inches thick.

The idea is an interesting one. Whether or not it is wholly or partially correct, the solution would seem to be the same—to prevent the presence in the subgrade, at any point within several vertical feet of the under side of the pavement, of any more moisture than the soil will retain by mere capillary attraction. Anything which causes water to collect at a given point, such as pot holes or depressions in an impervious substratum which has been filled in with sand or gravel, or similar depressions in a rock cut made in grading same, is to be avoided and the possibility of water collecting there eliminated. In the case of rock, probably the holes should be filled in with a lean concrete, and in the case of clay, by impervious material of the same nature as the rest of the stratum, the filling material in each case being brought up to a uniform grade with the rest of the surface. This at least will permit the water to distribute itself and possibly to drain away, where otherwise it would be held in these pot holes until it either produced a soft spot in the manner above suggested, or was gradually carried to the surface by capillary attraction and evaporated.

Our National Water Resources

At first thought the average citizen might not appreciate the importance to him of the conservation of the forests and wooded hills of the country, but engineers who have to deal with water supply and power plants should certainly do so. In an article in this issue Professor Saville sums up a great many of the ways in which municipalities are affected, these including the water supplies which are distributed through the city mains, the current which is used for lighting and power, the floods coming down from the upper waters of streams to do in some cases enormous damage to the cities along their banks, the use of the woods and forests as recreation areas, and other minor features.

In the early days of the country, when practically all of it except the prairie regions and deserts was covered with forest, the trees were looked upon by the settlers chiefly as something to be gotten rid of in preparing the land for cultivation. Even now a great many think of wooded land as waste land, which the proper utilization of our resources will ultimately clear off for the development of farms. To a certain extent it is true that the country at large would benefit more by farms than by forests; but a time is reached in each section of the country when the land most suitable for farming has been devoted to this purpose and the remainder might better be left to the trees which grow upon it, or such growth be encouraged as the most economical use of such land, considering all phases of the public welfare.

The reduction of our forests to the point where timber becomes more expensive than brick or stone for building houses (as is now the case in some European countries), and where stream flow is more irregular and floods more frequent, thus reducing the value of water power and increasing the damage from floods, are only two of the possibilities of neglect of this subject which should suffice to impress its importance upon people generally.

All of these things should be appreciated to the full by engineers engaged in connection with public works and public service, and they should be among the foremost proponents of the conservation of our forests.

Sewage Treatment in English and American Camps

The description in this issue of the experience of English engineers in sewering the English aerodrome camps bears a striking similarity to the accounts by American engineers of their experiences in United States camps during the war, although there are several points of difference. In each case it was found that the amount of sewage to be provided for was underestimated and that special efforts were necessary to keep the water consumption and resulting sewage within the desired limits. In the matter of grease, however, the experiences differed, in that the English engineers report that no trouble was experienced from the grease in sewage, while the American engineers experienced considerable difficulty with grease; both finding that the grease traps employed were of little benefit. No figures were given in the article as to the amount of grease found in the English sewage, and it is very possible that the different kind and amount of food supplied to the English soldiers as compared to the generous supply of meats and other fatty foods supplied to the American camps is the explanation of this difference..

The treatment in the English camps appears to have been more thorough than in most of the American camps, and the explanation is probably the same as that of the earlier and more general attention paid to sewage treatment in England than in this country, namely, that streams into which the effluents could be discharged were much smaller there than here, or in some cases were altogether lacking.

On the whole, there would appear to be little for American engineers to learn from the experiences in the English camps, but they will be interested at least in learning of the similarity of conditions and of the methods adopted for meeting them.

Red Bank's Water Works

In the Advance Contract News columns of the August 7 issue of Public Works appeared an item stating that engineers engaged by the town of Red Bank, N. J., had advised that the town's mains be connected with those of the Tintern Water Company. We have received further information concerning this from the engineers engaged by the town, Tribus & Massa of New York City. They state that at the time of writing, their report upon Red Bank's water situation had not been presented as yet, but that they had advised, as an immediate safeguard for fire protection, connecting with a large main of the Tintern Manor Water Company, though with no recommendation for taking water therefrom as a regular source of supply but simply in time of emergency.

St. Paul's Water Supply

St. Paul, Minnesota, derives its water supply from two systems of lakes, with an additional supply from wells when necessary. The lake systems extend twenty miles north of the city, the various lakes being connected by conduits and canals. Tests of the water are made regularly and chlorine is administered whenever the bacterial count indicates this to be desirable, and from time to time the city has been officially assured that its water supply is safe; now, however, the State Board of Health, having made a survey of the water system and situation, has advised the city to install a filtration plant. Whether it does so now or not, it is evident that it must do so eventually, since the supply from the lakes is little more than sufficient for the present consumption and it is probable that the additional supply must be drawn from the Mississippi river above Minneapolis. The most immediate threat to the purity of the supply, however, is the fact that the village of Forest Lake is building a sewer system which it is said will discharge into the drainage area of the lake supply. The advice mentioned was communicated by the State Board of Health quite recently and no action has yet been taken upon it so far as we are informed.

A Comprehensive Power Scheme for 15,000,000 Population

With a view to utilizing to the fullest extent the water power along the Atlantic Seaboard between Boston and Washington for the production of hydro-electric power, the U. S. Geological Survey is conducting an investigation for which congress has appropriated $125,000 and which it is expected will be completed in about eighteen months.

The director of the survey, George Otis Smith, stated that the chief objective of the survey is to investigate the possibilities of economy that might result from the establishment in the Boston-Washington industrial district of a general system for the generation and distribution of electrical power. Consideration will be had not only of the present demands of the area, but also of the future ones, including possible electrification of the railroads and more complete electrification of industries. It is estimated that at present only 10 per cent of the power used in the eastern seaboard district is developed by water power.

It is probable that the plans proposed will consist of a main artery which would be fed from generating plants along the route (including those already in use in the various cities), while feeders from the main artery will distribute the power wherever needed in the district. Existing plants would probably sell, for distribution by the main artery, the surplus power not needed in their own vicinity, and additional water power and steam generating plants would be established, their location being chosen with reference to source of power rather than point of demand.

Sewage Treatment at English Aerodromes

Bases of calculation and kinds of treatment given; ventilation, pumping, grease removal, and other details.

The following description of certain features of the methods employed in England for sewering the naval and military aerodromes during the war and treating the sewage is abstracted from a paper by D. Balfour which was read before the Association of Managers of Sewage Disposal Works at Cheltenham, England.

In each of the aerodromes the calculation of sewage volume was based on a flow of 25 gallons per head per day, which experience showed to be none too large; in fact, in most cases it exceeded this although the consumption was considerably cut down when steps were taken to prevent the waste of water at taps, flush tanks, etc. (This parallels the experience at aerodromes in this country).

In calculating the size of sewers, allowance was made for a quarter of the daily sewage flow discharging in one hour, or at a maximum rate of six times the average flow; but in practice it was found that the maximum hourly flow was one fifth the total, occurring usually between 8 and 10 A. M. Practically no surface water was received and there were no trade wastes. In the majority of aerodromes the population provided for varied from 400 to 2,000. But for repair depots provision was for 2,000 to 5,000, and for training schools up to 10,000.

Earthenware pipes were used for sewers. Where there was no automatic flushing, the minimum grade allowed was 1 in 100 for 6-inch pipe and 1 in 70 for 4-inch pipe; but in a number of cases where pumping would have to be resorted to unless flatter grades were used, the alternative was adopted and these were flushd by automatic tanks fed with water from the water mains.

"Ventilation was provided by means of 4-inch cast iron pipes at the heads of the sewers carried up the gables or above the eaves of buildings, and no intercepting traps were used on the sewers or drains owing to the liability to cause stoppages." (English practice does not yet generally countenance the omitting of intercepting traps for the purpose of ventilating sewers, as is more or less common in this country). "Grease traps were provided for the kitchens or cook houses, which might have been dispensed with as their cleansing was generally neglected, so that the grease was discharged into the sewers, but no trouble was experienced with the same." (Grease gave a great deal of trouble in the United States camps, as we described several months ago.)

The land chosen for aerodromes was the flattest obtainable, and this made it impossible in several cases to carry the sewers to an outlet without pumping. For this purpose centrifugal pumps were used driven by electric motors and provided with storage tank; the motors being automatically controlled by a switch operated by a float in the storage tank.

In some cases, however, ejectors using compressed air and having a capacity of from 70 to 300 gallons were employed. In most cases electricity was not available between 11 P. M. and 7 A. M., although it was during the remainder of the day, and an air receiver of 200 to 400 cubic feet capacity was placed outside the compressor house, which held air under 100 pounds per square inch, which pressure was reduced by a reducing valve to that actually required.

In some cases the sewage was discharged into the sewers of nearby cities. In a few cases the aerodromes were situated on the sea coast or a tidal river, and the sewage was discharged into a storage tank with about three-quarters of a day's capacity and the contents discharged on the ebb tide.

In the majority of cases, however, the sewage was treated. Effort was made to make the treatment works as automatic in their action and as fool proof as possible, requiring the minimum amount of attention. Previous experience had shown that disposal by irrigation was unsatisfactory, and in addition all land was being used intensively for food production. In the majority of cases the purification plant consisted of sedimentation tanks, percolating filters and humus tanks.

"The sewage, on reaching the disposal works, was discharged into a screening chamber, where large solid matter was intercepted by an iron screen fixed at an angle, the bottom being in a curved sump 12 inches below the invert of sewer to prevent blockage of screen and backwatering of the sewer. The intercepted matter was daily raked onto a wooden platform and conveyed by a barrow and dug into the land.

"The sewage then passed into rectangular concrete sedimentation tanks which in every case were in duplicate, so that there was always one tank ready to be put into commission when cleansing of the other was necessary. The total capacity provided was equal to one day's dry weather flow, so that the sewage was given about 12 hours stay in the tank. At the inlet and outlet ends, weirs were constructed to distribute the flow over the whole width of the tank, thereby reducing the velocity and preventing disturbance of the sediment deposited in the bottom. Scum boards let into grooves in the tank further stilled the flow as well as preventing the egress of any solid floating matter, including grease.

"The tank effluent then flowed into a dosing chamber of about one gallon per square yard of filter capacity, the contents of which were discharged by an automatic syphon and then passed through cast iron pipes to the revolving distributors.

"The filters, built on concrete floors, were enclosed with 9-inch brick walls, which were found to be as cheap as dry built battered stone walls of greater thickness. The media consisted of broken stone in most cases, as clinker was extremely difficult to obtain, and was graded from 1 inch to 2 inches in size, with a bottom layer 6 inches deep of 3-inch material acting as a drainage layer. On top of filter 6 inches of 3-inch media was placed—The depth of media varied from 4 feet 6 inches to 6 feet, dependent on the fall available."

The effluent from the filters was discharged into humus tanks with a capacity of three hours' flow and, having deposited in these any solid matter washed out from the filter, the effluent was usually discharged direct into the nearest watercourse. In some cases there were no streams and the effluent was distributed over a small area of land or into the soil by sub-irrigation drains.

In those cases where the stream was used for a domestic water supply, the effluent from the humus tank was passed through sand filters 18 inches deep, with a bottom layer of fine gravel or clinker overlaid with coarse, sharp sand. The outlets to these filters were controlled by stop valves so that a few inches head of water could always be maintained on the surface. This treatment was also given to the effluent where it was to be discharged in the vicinity of oyster or mussel beds.

The sludge from the tanks was placed in trenches 3 feet deep and 2 feet to 4 feet wide which, when about three-quarters full, were covered with excavated material.

In some cases where the ground levels permitted, double filtration was given to the sewage, the primary filter containing two-inch media and the secondary filter one-inch media.

At each plant a printed set of rules for operation and management was hung up in the tool houses provided for the men in charge, giving full instructions for the daily routine work. Bottles were provided for taking daily samples of effluent. One man was able to look after each of the smaller works efficiently, being given assistance when the tanks were cleaned, but two or three men were found necessary for the larger works. Two inspectors had as their sole duty the making of periodical visits to the works to see that they were properly managed and good effluents obtained.

These aerodrome sewage plants included 75 gravitation schemes, including tank, filters, etc.; 20 pumping schemes discharging to disposal works, 20 pumping schemes discharging into sewers or sewage disposal works of local authorities, and 9 plants discharging into tidal waters. The plants included altogether over 750 miles of sewer.

Philadelphia Employs More Engineers

While a comparatively small amount of public work is being done in a number of cities and counties of the country, the city of Philadelphia has so much under way that an ordinance was recently passed authorizing the director of the Department of Public Works to employ additional engineers in the Bureau of Surveys to handle the greatly increased work in the district survey offices.

Refuse Destructor at Syracuse, N. Y.

The matter of disposing of the refuse of Syracuse, N. Y., is arousing controversy between the aldermen of that city. A few years ago a plant which had been operated by private parties was leased by the city and operated by it until it was wrecked by an explosion last year. To replace this, the city has been building a reduction plant on which it has already spent $250,000, and $94,000 additional is asked for completing it. An ordinance authorizing an issue of bonds for this amount was rejected by the common council a month ago, the opponents stating that the best and cheapest thing for the city would be to abandon the plant which is under construction and not throw good money after bad.

The figures presented by the opponents are disputed by Henry F. Goldacker, Deputy Commisioner of Public Works in charge of garbage disposal. The opponents stated that it would cost the taxpayers 12 cents to reduce a pound of grease, for which the city is to receive 6 cents. Mr. Goldacker replies that it does not cost anything like 12 cents to produce a pound of grease, and that grease can be sold in the market today at 9 cents.

Basing his estimate upon the cost to other cities, which he says is about $1.85 a ton, it will cost Syracuse this amount for operation and $3 a ton for collecting the garbage and delivering it at the plant. He is quoted as stating that one ton of garbage will produce about 400 pounds of grease worth about $36 at the present market price. (This is probably a mistake, as 55 to 85 pounds is the most obtained by other cities). In addition, it will produce about one quarter of a ton of tankage worth about $20. This leaves over $51 a ton for paying interest and depreciation on the plant. (Estimating 75 pounds of garbage and $5 for tankage—more probable figures gives $6.90). The annual collection of garbage in Syracuse is about 15, 700 tons, showing an operating profit of $803,000 a year, according to these figures. (Using the figures suggested by the editor gives $108,330, or 30 per cent of the cost of the plant, which should be ample to cover interest, repairs and depreciation).

Damage to Toledo's Filtration Plant

On August 2 the division wall between the two sedimentation basins in the filtration plant of Toledo, Ohio, collapsed, carrying with it a section of the roof of the basin. One basin was being filled when the wall collapsed, and the pressure of this water was the cause of the accident. What weakened the wall so that it was unable to sustain the pressure which it should

have received with abundant safety had not been discovered at the time of this writing. It is expected that the basin, which is 100 feet wide and 500 feet long, will be cleared of the wreakage, which now occupies about two thirds of it, and ready for service again by about the middle of September.

Highway Construction in Illinois in 1920

Only one-fourth of this year's program can be completed, but this is equaled by no other state except Pennsylvania.

The Division of Highways of the state of Illinois claimed in the early part of August the work it had accomplished in constructing state highways this year was far in excess of that done by any other state except Pennsylvania, which was building about the same amount as Illinois.

In 1919 the department had let contracts for about 575 miles of roads, of which only about 175 miles was completed that year, leaving about 400 miles to be carried over into the present season. Contracts were awarded this year for fifty additional miles, but the department decided that it would be inadvisable to award any more contracts, for reasons already described in **Public Works** with reference to other states as well as Illinois.

With all of the efforts the contractors have been able to put forth, aided by the department, they have built this season only a little over one hundred of the 450 miles. If the contractors could have got deliveries of materials as required, fully twice as much pavement could have been laid without any additional expense to the state for supervision and very little additional overhead expense to the contractors.

As in other sections of the country, the delay was due to car shortage. In the latter half of 1919 the contractors were faced with a shortage of cars—first because of the strike of the railway car repairers, second because of the steel strike, and third because of an embargo placed on open-top cars due to the impending coal strike. Profiting by the 1919 experience, every effort was made by the contractors in 1920 to store sufficient sand, gravel, stone and cement to carry them well into the season; to this end they were given all possible assistance by the department.

It was found, however, that transportation conditions were worse than in 1919. First, came a more pronounced shortage of cars; this developed early in the year when it became impossible to get box cars for shipping cement. The cement companies resorted to the use of stock cars and open-top cars in order to overcome the shortage. Second, this shortage was greatly increased by the switchmen's strike. Third, the coal situation which tied up a very large number of cars for a considerable period of time became acute much earlier than usual, resulting in an order being issued by the Car Service Commission restricting the use of open-top cars to fifty per cent of the requirements of any producer of materials; and also providing that open-top cars could not be used for carrying commodities that could be as readily shipped in other classes of equipment. This order prevented the sand, gravel and stone products from getting sufficient cars to take care of the highway contractors; and also prevented the shipment of cement in open-top cars. Fourth, the order issued by the Car Service Commission was followed by an order from the Interstate Commerce Commission which provided that coal cars could be loaded with other commodities only when returning in the direction of the mines.

These two orders issued from Washington which are in effect at the present time have demoralized shipping conditions as applied to road building materials and made it impossible for the contractors to depend upon regular deliveries. Practically all of them have been obliged to shut down at frequent intervals because of the shortage of materials, some of them for weeks at a time. The department has kept in constant touch with the requirements of the contractors, with the material producers and railroad officials, endeavoring to assist in procuring cars and securing shipments of materials, so as to keep as many contractors as possible at work.

It requires about 450 cars per day to transport material for the highway work being carried on in Illinois and, assuming that it takes ten days for a car to make a round trip, it would be necessary to keep 4,500 cars in this service for the entire season.

More than forty contractors, many of them with two paving machines and several with three or more, have been in readiness to carry on this work since the early part of the season, but practically none of them have been able to operate more than one paving machine at a time.

In order to assist the contractors to obtain cement for the work, the highway department arranged some weeks ago for the shipment of 50,000 barrels of cement by barge from the plant of the Atlas Portland Cement Company at Hannibal, Missouri, to Alton and East St. Louis, this cement to be used on the National Old Trails Road and on the road from East St. Louis to Springfield. Up to August 7, 11,000 barrels had already been delivered and shipments were continuing, and it was expected that the entire shipment would be completed during the month of August.

In spite of these drawbacks, unless conditions become worse than at present most of the small contractors will have completed their contracts by the end of the season, while the larger contractors will have a very substantial part of their work done. There will be completed many stretches of pavement fifteen to twenty miles

long and several stretches seventy to one hundred miles.

Although paving materials were difficult to obtain, this did not interfere seriously with other work on the highways which could be done, especially constructing small bridges and culverts and grading. In many places there are heavy fills to be made which will require at least a year's time for settlement before pavements should be laid on them. A few weeks ago contracts were awarded for eight sections between Vandalia and Carbondale and bids were called for on August 11 and August 25 covering several other sections. With this heavy grading completed, pavements can be built next year in continuous stretches where otherwise it would be necessary to postpone the paving of these embankment sections until the grading has settled.

Delays in Pennsylvania Highway Work

The State Highway Commissioner of Pennsylvania, Louis S. Sadler, on returning from a tour of the state on August 14, stated that the several hundred contracts now in force are being seriously hampered through the inability of the contractors to obtain shipments because of embargoes on open-top cars. There are 267 contracts in force at the present time involving the construction of 993.29 miles of highways. This season to date 109.24 miles have been completed, which mileage could have been more than doubled with reasonably favorable conditions.

Extensive Highway Construction For Indiana

Lorenzo H. Wright, director of the Indiana Highway Commission, announces the program for 1921 to cover the paving of 500 miles of road and the maintenance of 2,500 miles of road at an expense of $26,000,000 or more. It is expected that maintenance will cost about $3,000,000 and that $2,500,000 additional may be secured by doubling automobile license fees.

Denver's Municipal Asphalt Plant

The city of Denver plans to lay 115,000 square yards of asphaltic concrete this year, the estimated cost of which is something over $200,000. This amount has never previously been laid by the city in one season but it is believed to be possible this year because of improvements which have been made at the municipal asphalt plant which have doubled its capacity. This plant is now turning out sufficient material to pave an average of 2,000 square yards a day, as much as 2,400 square yards having been laid in a day.

By the middle of July the city had laid 29,600 square yards on one street at a cost of $45,355, and 48,370 square yards on another street was nearing completion at that time.

Some of the streets to be paved this year are already paved with concrete, on which the asphaltic mixture will be laid after the surface of the concrete has been thoroughly cleaned. One district which will be paved this year was to have been paved six years ago at a cost of $1.64 per square yard but the property owners protested against it. They are now asking for the pavement although it will cost them $2.75 per square yard, the total area to be paved being 18,900 square yards.

The improvements at the asphalt plant, in addition to increasing capacity, have also increased the economy of operation, and it is estimated that $10.80 per ton will be saved in the purchasing and handling of the asphalt used at the plant. The saving in purchasing is due to the fact that the city is now able to order in carload lots, which permits a saving of $7 per ton over purchasing by the barrel which was necessary formerly. In addition, there was formerly a loss of asphalt in removing it from the barrels, which is now eliminated. This loss and the freight on the barrels is estimated by the superintendent of the municipal asphalt plant, Charles L. Draney, to amount to about $3 a ton.

The city orders asphalt in lots of five car loads. The asphalt is heated by the steam coils in the cars and run into a tank 40 feet long, 13 feet wide and 9½ feet deep. At the bottom of this tank are steam coils which keep the asphalt continuously heated and ready for pumping. From this tank the asphalt is pumped without any delay to the mixing plant.

Saving in handling at the plant is due mainly to the installation of a derrick and an asphalt pump and storage tank. By means of the derrick, using clam-shell buckets, the city is able to unload material and store it, and transfer it from the stock pile to the mixing plant more rapidly and economically than before, the derrick eliminating the use of three teams. For storing the material there has been built a three-compartment bin holding crushed slag and two grades of sand. The use of this bin prevents any intermission in the continuous operation of the plant waiting for one or another of the mineral aggregates.

The saving made at the plant is indicated by the pay roll last year and this, although this does not allow for the increased output of this year. The roll is made up twice a month, and beginning with the second half of March of 1919 and of 1920 respectively, the pay rolls were as follows: $2,533, $2,615; $3,345, $2,915; $3,659, $2,704; $4,744, $3,457; $4,515, $3,419.

In addition to the improvements at the plant, the department has added to its street equipment a conveyor and a heavy scarifying machine drawn by a caterpillar tractor. Two men at $8 per day on the conveyor take the place of eighteen shovelers at $4 a day. The use of the caterpillar-drawn scarifier replaces a considerable number of light, horse-drawn scarifiers and blades and is estimated to save nearly $100 a day; in addition to which the new machine cuts deeper and prevents the marcel wave effect left by the light machines.

Recent Legal Decisions

MATERIALMAN'S LIEN GOOD AS AGAINST ASSIGNEE OF CONTRACTOR

A road contractor entered into an agreement whereby he assigned his contract to one who financed him and who was to receive a specified portion of the proceeds. It is held, Stansbury v. Frazer, (Cal.) 189 Pac. 495, that the lien of one furnishing material to the contractor, and who filed with the county the notice of claim required by California Code Civ. Proc. § 1184, entitles the materialman to bonds or money due from the county to the contractor as against the assigne. It would make no difference whether or not the contractor took a subcontract under his assignee and the materials were furnished to the subcontractor.

IMPROVEMENT CONTRACTOR'S BOND PROTECTION TO MATERIALMAN

In a suit against the surety on the bond of a contractor with a city for a reinforced concrete floor for a viaduct in the city, the Ohio Supreme Court hold, Royal Indemnity Co. v. Northern Ohio Granite & Stone Co., 126 N. E. 405, that the rule of strict construction ordinarily applied in favor of privvate, voluntary sureties does not apply to the class of sureties which, for a pecuniary consideration, undertakes to indemnify an owner of a construction against the defaults of the principal contractor. In such contracts, where ambiguous terms are employed, that construction should be adopted, if consistent with the purpose to be accomplished, most favorable to the beneficiary. And a surety of this character, which, by its contract, assures the faithful performance thereof by a principal who agrees to furnish labor and materials on a structure, at his own risk, cost, and expense, is liable to a materialman who furnishes material, in default of the principal's payment therefor. Where contracts for improvements are entered into between an owner and a surety, which receives a premium for its engagement of fidelity, terms may be employed which fairly contemplate that financial protection of subcontractors, who employ labor and furnish material for the structure contemplated in the bond.

EMPLOYEES CANNOT SUE FOR WAGES UNDER NEW YORK STATE HIGHWAY CONTRACTOR'S BOND

The New York Court of Appeals holds, Fosmire v. National Surety Co., 127 N. E. 472, that a bond given by a highway contractor, under New York Highway Law, § 130, Subd. 7, conditioned for performance and completion of the contract within the time prescribed and for the protection of the state against excess cost, damages, etc., and for payment of wages, gives a cause of action in favor of the people only, and not in favor of a laborer for unpaid wages due from contractors to himself and fellow laborers under assignments. The dominant purpose of the bond, the protection of the state, would be defeated if laborers may ignore the public and sue in their own right. They may then sue for wages as often as there is default, and, exhausting the penalty of the bond, leave nothing for the state. The state did not intend to make the employees of its contractors the beneficiaries of a cause of action to be enforced in hostility to its own. A different question would arise if the bond had been conditioned for the payment of wages and nothing else. The interest of the state in the welfare of those who labor on its public works might then point to an intention to create a cause of action in their favor.

AGREEMENT AS TO MEASUREMENT OF SAND AND GRAVEL SOLD—RIGHTS OF MATERIALMEN FIXED BY LAW

Where a contract for material specifically stated the gravel was to be delivered at 2,600 pounds to the yard and sand at 2,400 pounds to the yard, these terms governed the parties and the purchaser could not change the form of measurement and employ a man to measure the sand and gravel under the reformed measurement without the knowledge or consent of the seller. The Louisiana Supreme Court also holds, Thompson v. O'Leary, 84 So. 116, that a contract of sale of cement prividing that "the usual credit of 10 cents each will be given on all empty cement sacks returned in good condition to the S. Cement Co., at Rockmart, Ga.," contemplated that the purchaser should stand the expense of delivering the empty sacks at the place designated.

The contractor having difficulty in giving a bond, the surety required him to have materialmen waive any lien or privilege they might have on the building to be constructed. It is held that a letter signed by the materialmen and addressed to the surety, waiving their rights of lien on the building, did not modify in any way contracts between the materialmen and the contractor. The waiver only affected the surety. Furnishers of materials for a warehouse constructed for the port commission of New Orleans served attested accounts upon the commission at a time when it had funds in its hands to the credit of the contractor more than sufficient to meet the several demands. The materialmen were held entitled to a judgment against the port commission for the amounts due from the contractor. The rights of materialmen are fixed by law, and nothing that the owner can do can change them.

LIMITATIONS OF BUILDINGS IN TOWNS AND CITIES

The Massachusetts Supreme Judicial Court holds, in re Opinion of Justices, 127 N. E. 525, that a proposed act, House Bill No. 1660, to authorize cities and towns to limit buildings according to their use or construction, is not violative of any of the provisions of the federal Constitution or its amendments.

NEWS OF THE SOCIETIES

COMBINATION ASPHALT KETTLE AND STEAM BOLER

Sept. 7-10—NEW ENGLAND WATER WORKS ASSOCIATION, Annual convention, Holyoke, Mass. Secretary, Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

September 13-16—PACIFIC COAST ASSOCIATION OF FIRE CHIEFS. Annual convention Los Angeles, Cal. Secretary, H. W. Bringhurst, Seattle, Wash.

September 13-17—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting San Francisco, Cal. Secretary, A. W. Hedrich, 169 Massachusetts Ave., Boston, Mass.

Sept. 16-18—ENGINEERING INSTITUTE OF CANADA. Meeting to be held at Niagara Falls, Ontario.

Sept. 20-23 — SOUTHWESTERN WATER WORKS ASSOCIATION, Annual convention, St. Charles Hotel New Orleans, La. Secretary, E. L. Fulkerson, Waco, Texas.

Oct. 12-14—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. St. Louis, 401 Lincoln Avenue, Valparaiso, Ind.

October 13-15—AMERICAN CIVIC ASSOCIATION. Annual convention Amherst, Mass. Secretary, E. F. Marshall, Union Trust Bldg., Washington, D. C.

October 16-19—AMERICAN COUNTRY LIFE ASSOCIATION. Annual conference Springfield Mass. President, Kenyon L. Butterfield, Amherst, Mass.

Oct. 19-22—INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. 25th annual convention, New Orleans, La. Secretary, C. R. George, Houston, Texas.

NEW ENGLAND WATER WORKS ASSOCIATION

The 39th Annual Convention will be held at Holyoke, Mass., Sept. 7-10. The office of the Secretary will be open at the Hotel Nonotuck at 8 A. M., September 7th, for registration. Registration cards will be sent to fill out and bring to the Convention.

Hotel Rates per Day, $1.50, up. Owing to the limited number of rooms available in the hotels, arrangements have been made to secure rooms in private homes.

For all information in regard to rooms, and for assignment of same, write Patrick Gear, Supt. Water Works, Holyoke, Mass.

EXHIBITS

Exhibits to be located in the City Hall. Water Works Manufactures Association Committee, Burt B. Hodgman, Chairman, 50 Church Street, New York, N. Y. The New England Water Works Asociation Committee, Harry H. Kinsey, Chairman, 201 Devonshire Street, Boston, Mass. Information regarding space for exhibits may be obtained from Burt B. Hodgman, Chairman.

PROGRAM OF PAPERS

(*It may be necessary to make some changes in this program, two or three additional papers are expected, but cannot be announced at this time.*)

Tuesday Afternoon, Sept. 7th, 1920, 2 o'clock.

Address of Welcome. Hon. John F. Cronin, Mayor of Holyoke; Mr. Thomas J. Carmody, Chairman Holyoke, Water Commissioners.

The Holyoke Water Works, and its Rainfall and Stream Flow Measurements, by Patrick J. Lucey, Engr., Holyoke Water Works. Final Report of the committee on Runoff. Robert E. Horton. Chairman. (*Have you measured any streams? Bring your dope.*)

TUESDAY EVENING, SEPT. 7, 1920 8 O'CLOCK

Experiences with Quicksand, by Col. Charles R. Gow, Cons. Engr, and Contractor, Boston, Mass. (*Come prepared to add your tale of woe.*) Final Report of Committee on Charges for Private Fire Protection, William C. Hawley, Chairman. (*The insurance men will doubtless have something to say.*) Report of Committee on Assessments for Main Pipe Extensions, Caleb Mills Saville, Chairman.

WEDNESDAY FORENOON, SEPT. 8, 1920, 9 O'CLOCK

Protecting Surface Water Supplies against Contamination, by X. H. Goodnough, Chief Engr., Mass., State Dept. of Health. (*What do you think of fishing in reservoirs?*) Some Color Characteristics of Unstripped Reservoirs by Caleb Mills Saville, Manager and Chief Engineer, Hartford Water Works. The Peabody Epidemic of 1913, and its Connection with the Water Supply, by Arthur D. Weston, Principal Assistant Engr., Mass., State Dept. of Health. (*A practical warning.*)

WEDNESDAY AFTERNOON, SEPT. 8, 1920, 2 O'CLOCK

Innocence or Repentance in Drinking Waters, by Harry W. Clark, Chemist, Mass., State Dept. of Health. (*Massachusetts' typhoid rate is one of the lowest, without chlorination of waters. What is the answer?*)

Lead Poisoning, Its Cause and Prevention, by Robert Spurr Weston, Consulting Engineer, Boston, Mass. A New Reinforced Concrete Pipe, by George C. Bartram, of United Concrete Pipe Co., of New York City. Progress Report of Committee on Standard Specifications for Cast Iron Pipe, Frank A. McInnes, Chairman. (*Two members of the Committee have recently visited some of the pipe founderies, and have matters of interest to report*)

WEDNESDAY EVENING, SEPT. 8, 1920, 8 O'CLOCK

(*In view of the present and probable future cost of fuel, efficiency in pumping is of prime importance. What are you doing in this direction? Come and tell us?*) Further Tests of the Unaflow Pumping Engine, By D. A. Decrow, of Worthington Pump & Machinery Corporation, New York, N. Y. Comparative Cost of Pumping by Steam and Hydraulic Power at Manchester, N. H., by James H. Mendell, Supt. Manchester Water Works. Modern Pumping Station Design and Operation, by Reeves J. Newsom, Commissioner of Water Supply, Lynn, Mass.

THURSDAY FORENOON, SEPT. 9, 1920, 9 O'CLOCK

The Chicopee Standpipe by V. P. Manan, Engr., Walsh's Holyoke Steam Boiler Works, (Builders of the Standpipe). (*This standpipe is of unusual size, and its design is a matter of considerable interest.*) Loss of Head in a 12-in Gate in a 16-in. Pipe by Thomas E. Lally, Asst. Engr., Water Dept., Boston, Mass. (*To what extent is it good practice to use gates of smaller size than the pipe in which they are located?*) The Relation between Office Methods, Regulations and the Water Consumer, by Reeves J. Newsom, Commissioner of Water Supply, Lynn, Mass., (*Good regulations are essential to good relations with water takers.*) Instructions to Employees at Pumping Stations and Filter Plants, by Dow R. Gwinn, President and Manager Water Co., Terre Haute, Ind. (*Methods used by a progressive and public spirited corporation.*)

FRIDAY FORENOON, SEPT. 10, 1920, 9 O'CLOCK

General Discussion on Experience with Trenching Machines, to be opened by George W. Batchelder, Water Commissioner, Worcester, Mass., and A. E. Martin, Supt. Water Works, Springfield, Mass. Interchange of Construction Plant between Water Departments, by Henry V. Macksey Supt. Public Works, Framingham, Mass. (*To what extent is it feasible to utilize plant to its fullest capacity by interchange?*)

FRIDAY AFTERNOON, SEPT. 10, 1920, 2 O'CLOCK

Special Superintendents' Session—Practical Problems.

Experience with an Exploded Pressure Boiler, and Check Valve on Service Pipes, by Edward J. Looney, Supt. Water Works, Belmont, Mass. Some Practical Points of Interest to Water Works Officials of Benefit to the Consumer, by David A. Heffernan, Supt. Water Works, Milton, Mass. Some Practical Experience with Distribution Systems, by George H. Finneran, Supt., Boston Water Works.

FRIDAY EVENING, SEPT. 10, 1920, 8 O'CLOCK

Operation of a True Siphon on a Main Supply Pipe, by W. R. Brann, Supt. Water Works, Hallowell, Me., and Charles W. Sherman, of Metcalf & Eddy Consulting Engrs., Boston, Mass. (*A part of this pipe is higher than the reservoir from which the supply is drawn.*) Water Waste Surveys in Boston, by Frank A. McInnes, Division Engineer, Boston, Mass. (*Where does the water go?*)

ENTERTAINMENTS

Tuesday afternoon. A whist party for the ladies at the Holyoke Country Club.

Tuesday evening. A whist party for the ladies at Hotel Nonotuck.

Wednesday morning. A visit will be made to the International Steam Pump Company Works; and to the Testing Flume of the Holyoke Water Power Company

Wednesday afternoon. Auto trip for the ladies

Friday morning a trip by auto will be made to the Holyoke reservoirs

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

COMBINATION ASPHALT KETTLE AND STEAM BOILER

A patent has just been allowed to Carl F. Hetherington of Indianapolis, Indiana, on an asphalt kettle which contains some quite novel features. The most apparent of these is the general idea of constructing an asphalt kettle surounding a steam boiler. Both kettle and boiler may be given any desired capacity. The illustration shows a combination with a kettle capacity of 15 tons of soft asphalt and a boiler capacity of 38 to 40 h.p. Designs have been prepared for others with 8 tons kettle capacity and 10 to 12 boiler h.p., and 3 tons kettle capacity and 50 boiler h.p.

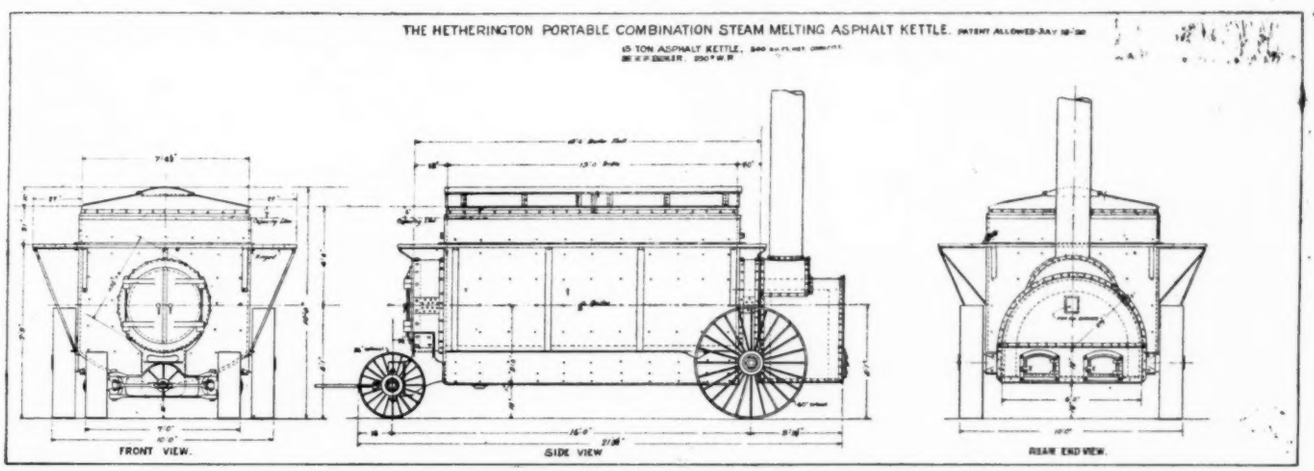
The boiler is a plain cylindrical flue boiler with the addition of return tubes, being thus somewhat akin to a Scotch marine boiler. It is designed for 200 to 250 pounds working pressure, A. S. M. E. specifications. The shell of the boiler is extended sufficiently beyond the front and rear tube sheets to form a support for the front and rear axles respectively, and also at the rear end to form an attaching ring for the fire box. The fire box is arranged with grates and also provided for burning fuel oil, so that either fuel may be used at will and without any rearrangements. The boiler containing water or steam in contact with its entire circumference and length, the asphalt in the kettle is in contact only with a steam or hot water heated surface and, as the furnace gases at no point come in contact with the outer shell of the boiler, the asphalt is at no point heated beyond temperature of the steam. Consequently those contractors who favor steam melting or are obliged by specifications to use only the steam melting system will appreciate this feature of this melting plant.

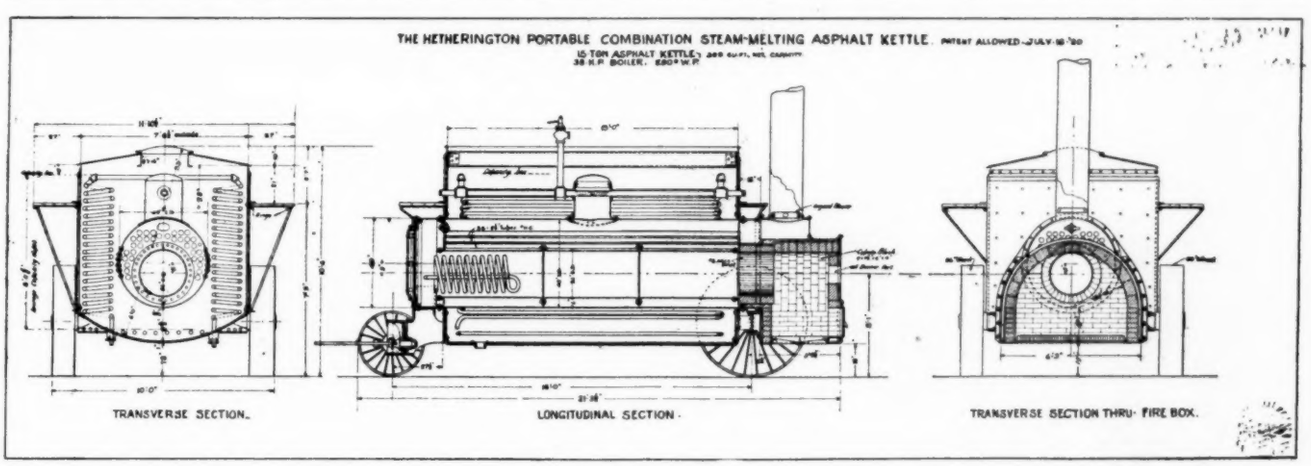
For use with the harder asphalts there is provided a steam super-heater coil in the front end of the boiler flue. This would not be required for the softer asphalts, but in using Trinidad asphalt better time could be made in melting it and the heavier ingredients of the material kept in agitation by using the super-heater coil for blowing steam. The plant is so designed that this coil may be readily removed or replaced in a few minutes without interfering in the operation of the plant.

In addition to the heating surface provided by the external surface of the boiler shell, steam coils are provided so that lump asphalt may be melted down and its temperature raised to 320 degrees Fahrenheit within six or eight hours after charging the kettle. These coils are arranged in banks which are easily removed from the top of the kettle, although it is probable that there would never be any occasion to remove them during the operating season because the coils are made of continuous welded extra heavy pipe.

The exterior surface of the kettle, which surrounds practically the entire length of the boiler, is lagged with a first class insulating material and this in turn protected by a sheet metal covering.

The combined plant is carried on four wide-faced traction wheels. The axle being pivoted in the center so that the superstructure is entirely protected against twisting strains in move-




THE HETHERINGTON PORTABLE COMBINATION STEAM-MELTING ASPHALT KETTLE.
TRANSVERSE SECTION.
LONGITUDINAL SECTION.
TRANSVERSE SECTION THRU- FIRE BOX.

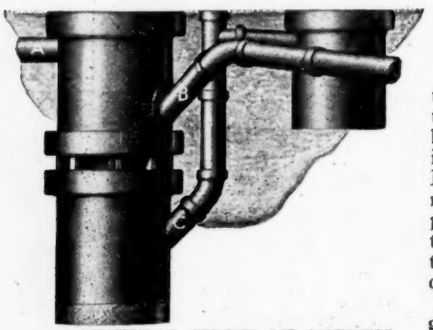
ment over the roads. A short drawbar connects with a transverse tie bar between the steering knuckles so that ease in hauling and steering and in making short turns is assured.

The boiler can be used not only for heating the asphalt in the kettle but also for furnishing the steam for melting asphalt received in tank cars, permitting the mixing plant to be run by electric motor if necessary and doing away with the necessity for a stationary boiler at the plant. In case the asphalt is received in barrels, as may be necessary when the road job is at some distance from the nearest railroad siding, the combination boiler and kettle here described can be used to advantage. There is but one unit to be transported over the road, and the boiler will furnish sufficient steam to melt down over night sufficient A C for a day's run (say -1200 to 1500 square yards of standard 2-inch sheet asphalt surface, or 1600 to 1800 square yards of bituminous concrete) and to maintain it at 300 to 320 degrees throughout the day; also to run a 25 to 53 h.p. engine or even larger.

No definite arrangements have yet been made for the manufacture of the combination steam melting kettle and boiler, but Mr. Hetherington expects to take up negotiations in the near future so that these melting kettles may be on the market for early spring deliveries next year.

FERGUSON SEWAGE DISPOSAL SYSTEM

A system and apparatus for disposing of the sewage of residences and institutions has been placed on the market by the Ferguson Segment Block Company of St. Louis, Mo. The apparatus consists of two tanks, one a two-story tank consisting of settling chamber and digestion chamber, and the other being a discharge chamber. The tanks are made circular in plan and are constructed of vitrified sewer pipe with a few special parts, as shown in the illustrations. The sewage enters through the pipe into the upper chamber of the two-story tank, where the solids settle out and drop into the bottom chamber through the annular space around the bottom of the cone, accompanied by more or less of the liquid. The liquid leaves the tank through the pipe B and is carried to

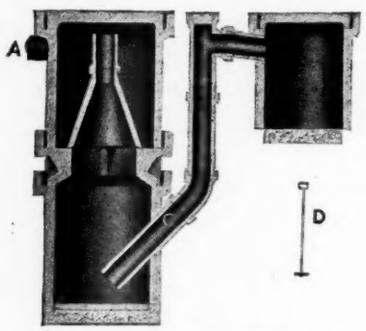


GENERAL VIEW OF SYSTEM

either a stream where it can be discharged, or to an underground irrigation system consisting of drain tile with open joints, laid 18 inches below the surface of the ground.

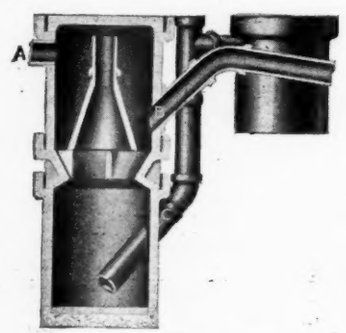
The gases from decomposition rise inside of the cone and escape through the opening at the top of it, thus not interfering with the settling out of the solids in the surrounding space.

The sludge gradually decomposes in the bottom chamber and about once every six months it is pumped into the discharge chamber by use of a simple plunger piston with a valve, which operates in the extractor pipe C, by simply working the pump up and down in the vertical part of that pipe. The discharge chamber is of only sufficient size to allow a limited amount of sludge to be taken from the digestion chamber at any one time, the idea being to prevent withdrawing undi-



SECTION THROUGH EXTRACTOR PIPE AND DISCHARGE CHAMBER

gested sludge. The sludge is left in the discharge chamber until it is thoroughly dry and of the nature of humus when it is spaded out like so much earth. If there is a large stream available, the digested sludge may be pumped into this and the discharge chamber omitted.



VERTICAL SECTION OF TWO-STORY TANK

Where the system is to provide for the sewage of more than fifty people the tanks are built with patented blocks, but the systems are the same in principle as those just described. However, underground irrigation is not generally practicable for such large plants, but some sort of sand filtration bed is more satisfactory. But for these large plants different cases require individual solutions.

The entire plant is installed underground, with the tops of the two-story tank, of the sludge extractor pipe, and of the sludge discharge chamber on a level with the surface, each of these being provided with a cover.

The standard models vary from one to 24 inches in diameter and 6 feet 10 inches deep for from one to five people, to one 36 inches in diameter and 13 feet 4 inches deep for from twenty to thirty people.

PERSONALS

Field, W. P., consulting engineer of Newark, N. J., died at West Orange, Aug. 8. He had constructed a number of large armories and manufacturing plants in New Jersey.

Larner, H. B., has been appointed health officer at Montclair, N. J.

Chase, W. G., formerly chief engineer of the Greater Winnipeg Water District, Canada, has been appointed manager of the Canadian Lock Joint Pipe Company with headquarters at Toronto.

Milne, Alex. has been elected president of the canadian section of American Water Works Association.

Dobbin, R. L., has been elected secretary of the Canadian section of the American Water Works Association.

Eaton, A. B., City Engineer of El Dorado, Kans., has resigned that position and accepted charge of a paving contract at Bartlesville, Okla.

Benedict, R. R., has been appointed assistant to chief highway engineer of the State of Illinois, Department of Public Works and Buildings.

Crawford, Colonel C. H., manager of the Baldwin Locomotive Works, Rio de Janeiro, S. A., has been appointed by the national Executive Committee of A. A. E. as "Chief Representative to the Latin American Republic."

Blanchard, A. H., professor of Highway Engineering and Highway Transport at the University of Michigan, has recently been appointed consulting engineer to the Michigan State Highway Department.

Sherman, LeRoy K., until recently president of the United States Housing Corporation at Washington, D. C., has become vice-president of the Edmund T. Perkins Engineering Company, First National Bank Building, Chicago. Mr. Sherman is president of the American Association of Engineers and was formerly engineer member of the Illinois River and Lakes Commission. The firm will conduct a general practice as consulting and supervising engineers in municipal, sanitary, and structural work, in addition to their past specialty of land drainage and reclamation.

HARLAND BARTHOLOMEW

Mr. Bartholomew announces the opening of new offices in the Compton Building, St. Louis, Missouri, for professional practice in city planning and allied subjects.

Mr. Bartholomew has directed the preparation of the comprehensive plan for St. Louis; has served as consultant to Omaha, Detroit and Pittsburg, and to the Commissioners of the District of Columbia appointed to prepare a zone plan for Washington, and has been retained to draw up complete city plans and zoning ordinances for a number of cities.

Associated with Mr. Bartholomew are: R. P. Hoffmann, Architect; Earl O. Mills, City Planner; and L. Tilton, Landscape Architect.